

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

App. No. : 10/711,262 Confirmation No. 5261
Applicant : Soichiro Okubo, et al.
Filed : September 7, 2004
T.C./A.U. : 2872
Examiner : Chapel, Derek S.
Docket No. : 39.003-C
Customer No. : 29453

Honorable Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

REPLY Under 37 C.F.R. § 1.111

Sir:

In response to the Office action of March 6, 2006, reconsideration of the above-identified patent application, amended as follows, is respectfully requested. (This response is being filed on June 6, 2006, and is therefore timely filed.)

AMENDMENT Pursuant to 37 C.F.R. § 1.121

Amendments to the Specification begin on page 2 of this paper.

Amendments to the Claims are reflected in the listing of claims that begins on page 5 of this paper.

Remarks begin on page 9 of this paper.

Amendments to the Specification (other than claims):

Please replace paragraph [0023] with the following amended paragraph:

[0023] Further preferably, the polarizer and the analyzer are characterized in being
lent a structure having distributed refractive indices, by irradiating with either a
particle beam or an energy beam a diamond-like carbon (DLC) thin film along a bias
with respect to the film's thickness direction.

Please replace paragraph [0045] with the following amended paragraph:

[0045] Fig. 12 is a chart diagramming measurement results on the spectral
transmission characteristics of a DLC thin film actually fabricated using the parallel-
plate plasma [[CVD]] chemical vapor deposition (CVD) method;

Please replace paragraph [0051] with the following amended paragraph:

[0051] The magneto-optical part 30-1 is constituted from a gadolinium iron garnet
(GIG hereinafter) thin film, and the dielectric multi-layer films 30-2 are composed by
laminating in alternation silicon dioxide ~~oxide~~ as a low refractive-index layer, and
titanium dioxide ~~oxide~~ as a high refractive index layer.

Please replace paragraph [0055] with the following amended paragraph:

[0055] Figs. 2 through 7 are diagrams representing, according to simulations, the function of Faraday rotators that selectively rotate the polarization plane of incident light of given wavelength(s). Data for tantalum oxide (Ta_2O_5) as a substitute for a GIG thin film, and further, data for silicon dioxide ~~oxide~~ (SiO_2) as a low refractive-index layer and for titanium dioxide ~~oxide~~ as a high refractive-index layer in the dielectric multi-layer film, are respectively used for the simulations illustrated by Figs. 2 through 7.

Please replace paragraph [0056] with the following amended paragraph:

[0056] Transmission characteristics yielded in shining infrared light of 1000 to 2000 nm in wavelength on a multi-layer film made up of the tantalum oxide, silicon dioxide, ~~oxide~~, and titanium dioxide ~~oxide~~ were calculated from the simulations.

Please replace paragraph [0102] with the following amended paragraph:

[0056] Accordingly, that at the 1500 nm wavelength hypothesized for optical communications, the DLC thin film fabricated in this instance has a remarkably low extinction coefficient compared with conventional ~~[[DCL]]~~ DLC was verified. Furthermore, it can be read from Fig. 13 that even for a wavelength not only of 1500 nm, but also in the range of 1200 nm to 1700 nm, the extinction coefficient for the DLC thin film fabricated in this instance is 3×10^{-4} or less, which is lower than the 4

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$\times 10^{-4}$ of conventional DLC. Advantages such as that the lower the extinction coefficient, the less is the signal attenuation in, e.g., the optical communications field will be appreciated.

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the present application.

Listing of Claims:

Claims 1-10 (cancelled)

Claim 11 (currently amended): A method of qualitatively transforming a diamond-like carbon (DLC hereinafter) film to create a distributed refractive index structure within the DLC film, the method comprising the ~~step~~ steps of:

adhering a mask to a top surface of the DLC film, the mask including a transcription of the distributed refractive index structure; and

irradiating the mask and the DLC film, with either a particle beam or an energy beam, such that first selected regions of the DLC film receive said radiation, and second selected regions of the DLC film are blocked by the mask from receiving said radiation, said radiation effective at least one region of the DLC film to raise a [[the]] refractive index of the first selected regions such that the that region, whereby a distributed refractive index structure is created within the DLC film.

Claim 12 (currently amended): [[A]] The DLC film-transforming method as set forth in claim 11, wherein:

said particle beam is one selected from the group consisting of an ion beam, an electron beam, a proton beam, α -rays, or a neutron beam; and

said energy beam is one selected from the group consisting of light rays, X-rays or γ -rays.

Claims 13-21 (cancelled)

Claim 22 (currently amended): ~~[[A]]~~ The DLC film-transforming method as set forth in claim 11, wherein the qualitative transformation is carried out on one selected from the group consisting of a hydrogen-containing DLC ~~film; film,~~ a nitrogen-containing DLC ~~film; film,~~ and a non-hydrogen-containing, non-nitrogen-containing DLC film.

Claim 23 (currently amended): ~~[[A]]~~ The DLC film-transforming method as set forth in claim 11, wherein the qualitative transformation is carried out on a DLC film having, with respect to light having a wavelength within a range of from 550 nm to 650 nm, a refractive index smaller than 1.6 and an extinction coefficient smaller than 1×10^{-3} .

Claim 24 (currently amended): ~~[[A]]~~ The DLC-film-transforming method as set forth in claim 11, wherein the DLC film is irradiated with either the particle beam or the energy beam at a bias with respect to the film's thickness, whereby the distributed refractive index structure is created sloping with respect to the film's thickness.

Claim 25 (currently amended): A DLC film characterized by having refractive indices distributed in a pattern oriented within ~~[[the]]~~ a plane of the film, the pattern including a plurality of alternating first and second linear regions in the plane of the film, the first regions having a first refractive index and the second regions having a second refractive index, ~~the DLC film including a plurality of qualitatively transform regions in which the refractive indices are changed.~~

Claim 26 (currently amended): The DLC film of claim 25, wherein the alternating first and second linear regions ~~a DLC film characterized by having refractive indices distributed in a pattern~~ are oriented on a bias with respect to ~~[[the]]~~ a thickness of the film.

Claim 27 (cancelled)

Claim 28 (currently amended): ~~[[A]]~~ The DLC film characterized by having a distributed refractive index pattern, the DLC film including a plurality of qualitatively transformed regions in which the refractive indices are changed, the ~~[[DCL]]~~ DLC film created by a film-transforming method as set forth in claim 11.

Claim 29 (currently amended): ~~[[A]]~~ The DLC film characterized by having a distributed refractive index pattern, the DLC film including a plurality of qualitatively transformed regions in which the refractive indices are changed, the ~~[[DCL]]~~ DLC film created by a film-transforming method as set forth in claim 12.

Claim 30 (currently amended): ~~[[A]]~~ The DLC film characterized by having a distributed refractive index pattern, the DLC film including a plurality of qualitatively transformed regions in which the refractive indices are changed, the ~~[[DCL]]~~ DLC film created by a film-transforming method as set forth in claim 22.

Claim 31 (currently amended): ~~[[A]]~~ The DLC film characterized by having a distributed refractive index pattern created by a film-transforming method as set forth in claim 23.

Claim 32 (currently amended): ~~[[A]]~~ The DLC film characterized by having a distributed refractive index pattern created by a film-transforming method as set forth in claim 24.

Claim 33 (new): A method of qualitatively transforming a DLC film, the method comprising the step of radiating with either a particle beam or an energy beam at least one region of the DLC film to raise the refractive index of that region to form a distributed refractive index within the DLC film; wherein, with respect to light having a wavelength within a range from 550 nm to 650 nm, the DLC film has a refractive index less than 1.6 and an extinction coefficient less than 1×10^{-3} .

Claim 34 (new): A DLC film characterized by having refractive indices distributed in a pattern oriented within the plane of the film, wherein, with respect to light having a wavelength within a range from 550 nm to 650 nm, the DLC film has a refractive index less than 1.6 and an extinction coefficient less than 1×10^{-3} .

Claim 35 (new): The DLC film of claim 25, wherein the first and second linear regions each have an in-plane thickness of less than about 200 nm.

Claim 36 (new): The DLC film of claim 25, comprising at least 10 of each of said first and second linear regions.

REMARKS

Status of Claims & Summary of Amendments

1. Claims 1 through 21 were originally presented in this application. By Applicants' preliminary amendment of November 1, 2004, claims 1 through 10 and 13 through 21 were cancelled and new claims 22 through 27 were added. Claims 11 and 12 were amended in the same preliminary amendment. In a response to a first Office action on the merits, multi-dependent claim 27 was cancelled and rewritten as five distinct new dependent claims 28, 29, 30, 31, and 32.
2. Claims 11, 12, 22-26 and 28-32 have been examined in the present Office action (mailed by the USPTO on March 6, 2006). An indication of allowability was given to claims 23 and 31. Claims 11, 12, 22, 24-26, 28-30 and 32 were rejected for various reasons as set forth in the Office action.
3. In this paper, allowed claims 23 and 31 have been rewritten in independent form as new claims 33 and 34, respectively. Additional new claims 35 and 36 have also been added. No claims have been canceled in this paper. Claims 11, 25, and 26 have been amended, as described in more detail below, to more particularly point out and distinctly claim the inventive material of the instant invention. Claims 11, 12, 22-24, and 28-32 have also been amended to address various informalities noted by the Examiner. Claims 11, 12, 22-26, and 28-36 remain pending.

Specification/Claim Objections

4. The disclosure was objected to because of various informalities. Paragraphs [0023], [0045], [0051], [0055], [0056], and [0102] have been amended in accordance with the Examiner's suggestions to address these informalities. No new matter has been entered.
5. Claims 11-12, 22-24, and 28-32 were objected to because of various informalities. Claims 11-12, 22-24 and 28-32 have been amended in accordance with the Examiner's suggestions to address the noted informalities. These amendments are ministerial and non-substantive in nature. They are not related to patentability, and are not intended to (and are not believed to) alter the scope and/or subject matter of the amended claims as presented originally. No new matter has been entered.

Double Patenting

6. Claims 11, 12, and 24 stand rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims of 4, 6, and 7 of U.S. Pat. No. 6,813,076 to *Okubo* in view of *Zhang et al.* (*Structural Modification of Polymeric Amorphous Hydrogenated Carbon Films . . .*). Independent claim 11 (from which claims 12 and 24 ultimately depend) has been amended as described in more detail below. Applicant therefore respectfully submits that the double patenting rejection no longer applies. In particular, claims 11, 12, and 24 (in view of the amendments to claim 11) are believed to be patentable over claims 4, 6, and 7 of *Okubo* in view of *Zhang et al.*

Claim Rejections - 35 U.S.C. § 102

7. Claims 11-12, 22, 24-26, 28-30, and 32 stand rejected under 35 USC 102(b) as being anticipated by *Brady et al.* (U.S. Pat. No. 5,294,518). Additionally, claims 11, 12, 22, 24, 26, and 32 stand rejected under 35 USC 102(b) as being anticipated by *Zhang et al.*
8. Applicant respectfully traverses these rejections to the extent that they are pertinent to amended independent claim 11. Independent method claim 11 has been amended to recite the additional step of:

adhering a mask to a top surface of the DLC film, the mask including a transcription of the distributed refractive index structure.

Amended claim 11 also recites:

irradiating the mask and the DLC film, with either a particle beam or an energy beam, such that first selected regions of the DLC film receive said radiation, and second selected regions are blocked by the mask from receiving said radiation, said radiation effective to raise the refractive index of the first selected regions such that the distributed refractive index structure is created within the DLC film.

The amendments to claim 11 are supported by Fig. 10 and Paragraph [0088] of the original specification, such that no new matter is entered and no new search should be required.

9. Applicant respectfully submits that, as amended, independent claim 11 now distinguishes patentably over both *Brady et al.* and *Zhang et al.* In particular, there is nothing in either *Brady et al.* or *Zhang et al.* (or any other prior art reference of record) that teaches, discloses, or even suggests, "adhering a mask to a top surface of the DLC film, the mask including a transcription of the

distributed refractive index structure" and "irradiating the mask in the DLC film, . . . such that first selected regions of the DLC film receive said radiation, and second selected regions are blocked by the mask from receiving said radiation." Accordingly, independent claim 11, as amended, is allowable over the prior art of record.

10. Applicant also respectfully traverses these rejections to the extent that they are pertinent to amended independent claim 25. Independent claim 25 has been amended to recite:

A DLC film characterized by having refractive indices distributed in a pattern oriented within the plane of the film, the pattern including a plurality of alternating first and second linear regions in the plane of the film, the first regions having a first refractive index and the second regions having a second refractive index.

The amendment to claim 25 is supported by Fig. 10 and Paragraph [0090] of the original specification, such that no new matter has been entered and no new search should be required.

11. Applicant respectfully submits that, as amended, independent claim 25 now distinguishes patentably over both *Brady et al.* and *Zhang et al.* In particular, there is nothing in either *Brady et al.* or *Zhang et al.* that teaches, discloses, or even suggests, a DLC film "having refractive indices distributed in a pattern within the plane of the film, the pattern including a plurality of alternating first and second linear regions in the plane of the film, the first regions having a first refractive index and the second regions having a second refractive index." Accordingly, independent claim 25, as amended, is allowable over the prior art of record.
12. Independent claims 11 and 25 being allowable, it follows that dependent claims 12, 22-24, and 28-32 (which depend directly or indirectly from independent claim 11) and claim 26 (which, as amended, depends from independent claim 25) must also be allowable, since these dependent claims carry with them all the elements of the independent claims to which they ultimately refer.
13. As stated above, original claims 23 and 31 have been rewritten in independent form as new claims 33 and 34, respectively. New claim 33 includes each of the elements of previously presented claims 11 and 23 and new claim 34 includes each of the elements of previously presented claims 11, 23, and 34, such that no new matter has been entered and no new search is required. Applicants respectfully submit that new claims 33 and 34 should be allowable, since the Examiner gave an indication of allowability to previously presented claims 23 and 31.

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14. New dependent claims 35 and 36 have been added. New claim 35 is supported by Paragraph [0090] of the original specification and new claim 36 is supported by Fig. 10 (as well as Paragraph [0090]), such that no new matter is entered and no new search should be required. New claims 35 and 36 both depend from independent claim 25 and therefore should be allowable for the same reasons discussed above in paragraphs 10 and 11, as well as for their additional elements.

Accordingly, Applicant courteously urges that this application is in condition for allowance. Reconsideration and withdrawal of the rejections is requested. Applicants request reconsideration and allowance of pending claims 11, 12, 22, 23, 24, 25, 26, 28, 29, 30, 31, 32, 33, 34, 35, and 36. Favorable action by the Examiner at an early date is solicited.

Respectfully submitted,

June 6, 2006

/James Judge/

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